The Radiative Heating in Underexplored Bands Campaign (RHUBC): Evaluating Water Vapor Spectroscopy

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Radiative heating and cooling are important drivers of Earth's climate. In the mid-to-upper troposphere, the dominant radiative processes in both the solar and thermal regimes are due to water vapor. These processes are imperceptible from the ground in typical conditions due to absorption by water vapor in the intervening lower atmosphere. We will present the motivation and initial results from the RHUBC, a series of ground-based campaigns conducted under the auspices of the Atmospheric Radiation Measurement (ARM) program. The primary objective of RHUBC is to deploy state-of-the-art radiometers and spectrometers in dry environmental conditions so that the strong water vapor absorption bands remain semi-transparent. Radiosondes are also launched frequently to provide atmospheric state measurements. The first phase of the campaign, RHUBC-I, was conducted in February-March 2007 in Barrow, Alaska, with minimum observed precipitable water vapor (PWV) of 0.9 mm. The second phase, RHUBC-II, was conducted from August to October 2009 at an altitude of 5.3 km in the Atacama Desert, Chile; PWV values as low as 0.2 mm were observed. The RHUBC measurements span the microwave to the near-infrared, comprising a robust and complete dataset for evaluating water vapor line parameters and the water vapor continuum and providing a unique opportunity to assess the consistency of water vapor spectroscopy between the different spectral regions. In this presentation, we will focus on model/measurement comparisons in the microwave and sub-millimeter regions. Instrumentation deployed during RHUBC-II included a spectrally resolved sub-millimeter instrument - the Smithsonian Astrophysical Observatory Fourier Transform Spectrometer. Measurements from this instrument bridge the spectral gap between the regions covered by microwave radiometers and infrared spectrometers, allowing valuable ground-based validation of radiative transfer models from 300 GHz to beyond 1 THz.

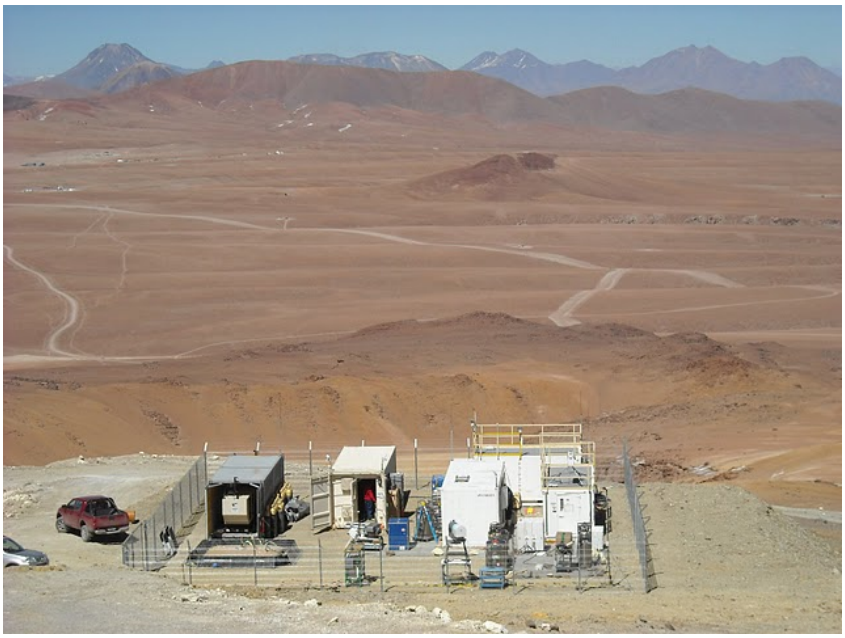

Figure 1. RHUBC-II was conducted from August to October 2009 at an altitude of 5.3 km in the Atacama Desert, Chile.